

Portable Quadrupole Mass Spectrometer for Non-Invasive Disease Detection

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Biomedical sensors for early stage disease detection is required to improve quality of life. Limitations related with conventional sensors are selectivity, sensitivity, cross-reactivity, etc. and also have invasive detection approach. Lack of precision and high accuracy of conventional devices can be overcome by miniaturized portable mass spectrometer.

Mass spectrometry is a gold-technology, which can give both qualitative and quantitative information about chemical compounds. In this technique, materials are sorted using their mass-by-charge (m/z) ratio. In mass spectrometer, sample is ionized first to form ions which are then passed through mass analyzer which sorts the specific ions and ions of selected m/z will be detected by the detector as shown in fig. 1(a). Large size and high vacuum requirement make this system costly and unsuitable for in-field applications specially biomedical. Miniaturization and portability can make this instrument suitable for biomedical applications. In this paper, we present the design of portable quadrupole mass spectrometer for the detection of acetone as a non-invasive glucose detection method.

Quadrupole mass analyzer consists of four parallel cylindrical electrodes. On these electrodes, combined DC and AC voltage is applied to select the desired mass by charge ions to pass. The QMF is designed in COMSOL 5.4 in particle tracing module. The length of designed electrodes is 70mm and for m/z 43 (acetone), simulated design and stability curve is shown in figure 1(c) and 1(d). Mathieu's parameters a and q are 0.03 and 0.9 for m/z 43 (base peak of acetone).

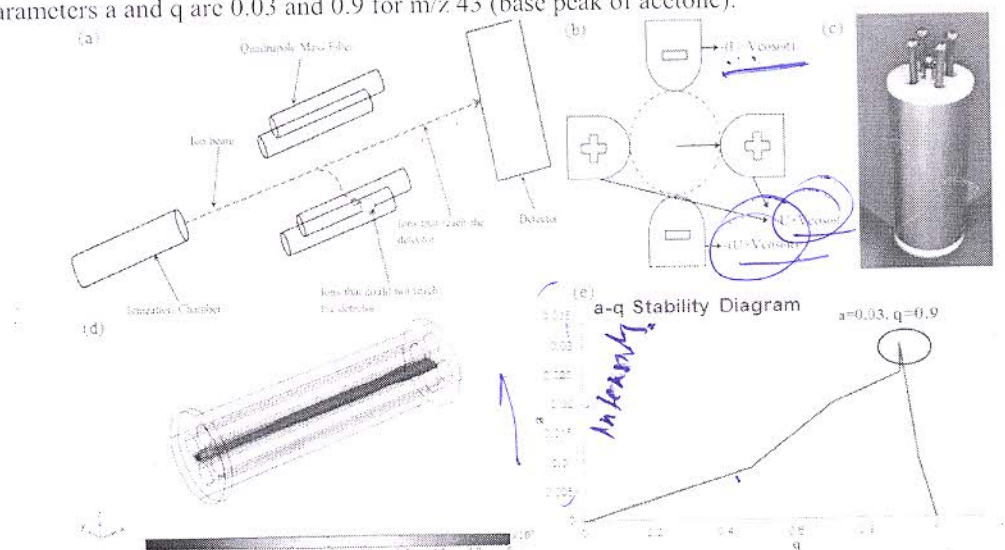


Figure 1: (a) Schematic of quadrupole mass spectrometer, (b) Quadrupole mass filter electrode, (c) designed QMF, (d) simulated design for m/z 43 amu and (e) a-q stability diagram for m/z 43 amu.

References

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